AIC's general response to the Productivity Commission report into Public Support for Science and Innovation

The report from the Productivity Commission provides a tremendous overview as well as tutorial commentary on science and innovation policy in Australia. It contains much food for thought. With the exception of a few topics discussed below, the AIC believes the report makes sound arguments in a rational and measured way.

The AIC's core mission is to facilitate the demand-driven application of knowledge, which we refer to as commercialisation. Such application requires a source of knowledge (in the current context, a research organisation) and a developer of knowledge that can then take it to market for application (typically, a company, but sometimes government). Core to fostering such knowledge application is establishing collaborations between the 'supplier' and 'developer' (although such a characterisation is a very crude way of describing their respective contributions since knowledge transfer is neither binary nor linear). It is the AIC's experience that SMEs, because of their agility, are well placed to identify and satisfy market demand, but because of their size and capacity for risk, are frequently unable to form such collaborations unassisted, since they require significant levels of trust (and resources) to establish. For this reason, the AIC has developed its active intermediary program, TechFast, to reduce the transaction costs, lack of trust, and market failure that work against SMEs collaborating with the research sector. TechFast is the subject of a separate paper requested by the Productivity Commission as part of this review.

We believe the additionality of intermediary programs such as TechFast are clear: there are very few SMEs able to collaborate with the research sector in the absence of programs like TechFast. The spillover effects are also demonstrable, because although the collaboration may produce economic benefits for a single SME, there are broader benefits to be gained: further extensive R&D, participation of regional SMEs and subsequent multiplier effects, enduring collaborations and skills beyond the initial facilitated collaboration, job creation and growth, and a demonstration effect as other SMEs observe the benefits and respond accordingly. As a result of this program, the AIC is observing the seeds of new or transformed industries emerging, as it works with SMEs to encourage collaboration resulting in the application of new research and knowledge to increase innovation.

With this background, the AIC is pleased to submit its general response to the Productivity Commission report into 'Public Support for Science and Innovation'.

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Our comments on the draft report are centred around four major themes.

I. The first theme is that the relationship between innovation policy and industry development is simply dismissed. This is contrary to the view of many academics, and the outcomes from a number of State Government policies.

The AIC strongly agrees with the view expressed in one of the submissions that innovation policy should be a source of competitive advantage for Australian industry *[6.7 Ultimately, policy should not be judged on whether a particular company or industry flourishes but on whether, taken as a whole, Australian firms are increasingly able to develop and commercialise innovation for global competitive advantage and as a source of prosperity for Australia going forward]*. Achieving impact from research is necessary for industry formation and transformation, as well as for industrial growth and sustainability. To achieve such impact ultimately requires adaptation or integration of other research, channels to market, marketing, distribution and logistics, as well as capital and an entrepreneurial culture. Our first point (in passing) is that these non-science aspects have not been systematically considered by the Commission. For example, the AIC has received funding from many government agencies (as well as research organisations) around Australia to deliver its Commercialisation Bootcamps and Ideas2Market seminars. Such agencies are pursuing strategies intended to foster company creation and growth, believing in a clear linkage between that goal and the coupling of entrepreneurship skills with science.

However, the view of a positive relationship between innovation policy and industry development is not consistently held throughout the report. For example, the report states *[9.46… a number of the CRC selection criteria... — including the creation of new jobs, increased exports, expansion of import replacement activities or assisting emerging industries — are not valid objectives for government policy aimed at influencing science and innovation activity]*.

Why not? The defence that industries can either develop from scratch or transform themselves through market forces alone is one that not all economists would take for granted. Customers and markets are generally focussed on meeting short term needs or returns, while industry development requires longer term, strategic thinking.

We would also point out that one of the four National Research Priorities announced by the Prime Minister is [*8.19 frontier technologies for building and transforming Australian industries*], with *[the broad areas receiving the most attention (being) ICT, biotechnology and nanotechnology]*. This unequivocally expresses the desired relationship between research policy and industry development i.e. innovation policy and appropriate research should encourage the formation or transformation of companies able to build such industries. This is at the heart of a number of government initiatives, and in the AIC's view, the absence of tighter coupling between science, innovation, and industry policy is problematic.

Again, the report states *[3.33…The realistic scope for industry-specific innovation policies of the kind envisaged to transform Australia's industry structures appears weak. The transformative goals of past policies do not appear to have achieved their original*

aspirations. Moreover, the definition of innovation usually adopted when referring to transformation tends to place excessive weight on technological innovation, downplaying the arguably more important role of wider routes to doing things better. As noted previously, the most clearly transformed sector in Australia is the services sector, where technological innovation has played a relatively attenuated role in contrast to adoption and non-technological innovation].

On the rise of the services sector, the AIC would argue that it is frequently technological innovation that has enabled this sector to emerge in the first place, as it has for example, in the mining or viticulture industries. We would also challenge the Commission to name a single national economy with an advanced services sector that is not underpinned by innovation within an underlying industry dependent on technology, or at the very least, the novel application of ICT. We also consider that the maintenance of at least niche manufacturing capability is essential for many related service industries to be viable (for example, those in design or technological integration). This is particularly evident, for instance, in the mining sector. The relationship between services companies and innovative product-based industries that underpin them is unexplored, and it is dangerous to assume they can be decoupled. As the Commission itself asserts *[6.6 While it is true the Australian manufacturing sector has declined in relative terms, this trend is a common feature of higher income countries. Despite this, the sector continues to play a major role in the Australian economy in terms of output and employment, and as the dominant source of technological innovation in the business sector (PC 2003b)]*.

The report also errs in stating that [*6.8 While the Commission sees little evidence from an economy wide perspective of a problem with firms not fully exploiting knowledge and technology to add value, there are two important qualifications. First, the aggregate picture may mask problems in particular sectors and industries…..Secondly, the aggregate picture does not indicate the extent to which Australia could be leveraging more from public investment in science and innovation]*. The AIC would dispute the initial assertion. For example, "Australian companies are much less likely to use external technologies than overseas companies, with 34% of Australian firms using such technologies compared to 86% in Europe and 85% in the United States… Australia's use of early stage R&D is also low relative to overseas firms"[1]. The aggregate picture would appear to give an equally dim view of industry exploitation of new knowledge and technology, not just particular sectors.

The AIC agrees with the view of the Commission that industry policy needs to be broadly demand driven. For example, *[6.17 In the Commission's view the structure of the Australian economy should be seen as an important factor shaping the demand-side of the commercialisation ledger rather than a constraint per se. While there may not always be strong local demand for the knowledge and technology generated by research organisations, the community can still benefit from the sale and licensing of intellectual property to overseas buyers]*. However, a legitimate follow-on question that should be addressed therefore is could the economy benefit from stimulation of demand, and is there latent sophisticated demand that is poorly articulated?

[1] DEST report, 'Mapping Australian Science and Innovation, Main Report' 2003.

The potential role of public procurement in perhaps focussing or expressing such demand is not addressed by the report. We would recommend that the Commission consider the USA's SBIR scheme, which is now also being implemented in the UK. The scheme has a number of benefits. Hughes notes[2] "the (full cost) contract nature of the relationship (between the agency and research SME in SBIR) helps develop reputation and competence in the early stages of company start-up. The existence of a contract as opposed to a grant both helps harden up the development of early stage businesses and also makes them more attractive propositions when they seek funding for further development from the financial sector and other sources. This potential role for public procurement which was relatively neglected in the original UK Science and Innovation Investment Framework report has been given more emphasis in the follow-up programme (HM Treasury et al (2006)). Thus in the budgets of 2004 and 2005 moves were made to make it mandatory for Government Departments and Agencies to place 2.5% of their extra mural R&D contracts with small and medium sized enterprises through the Small Business Research Initiative Programme."

II. The second concern is that strategy cannot be formulated by only surveying the 'now', it requires foresighting, laying out a vision and looking at the difference between now and where you want to be. Strategy should not be about making incremental changes to the status quo.

Granted, this requires a political component that the Productivity Commission may not believe it is in a position to give.

Although outside its terms of reference, the report does not strategically ponder what a perfect science and innovation system should look like. It argues instead for incrementalism, ignoring, for example, how the National Research Priorities might be better achieved (which of course do specify the political requirement). One would assume that strategy should be attempting to achieve more from public investment in R&D. Even the Commission itself confesses that [6.8 *the aggregate picture does not indicate the extent to which Australia could be leveraging* ***more*** *from public investment in science and innovation*]. Instead, the report focuses on improving the economic efficiency of the existing system.

The report looks at concepts seen through the lens of market failure, and assumes that industries will emerge or transform in response to economic forces. In a rapidly changing external environment, and one where other countries are pursuing strategies not linked to market forces, a model assuming such long term economic equilibrium has limited applicability. South Korea in the past decade is a good example, in which neither its automobile nor electronics industries were developed in response to pre-existing business competencies or market failure: rather, they were strategically pursued. India and China and many developed countries are following similar strategies today. **Innovation does not**

[2] Alan Hughes, "University Industry Linkages and UK Science and Innovation Policy", Centre for Business Research, University Of Cambridge, Working Paper No. 326, June 2006

necessarily arise in response to a firm's realisation that long term economic survival depends on its pursuit. Rather, it frequently arises because interactive structures and collaborations are strategically pursued as policy imperatives, and serendipity or synchronicity then occur with resultant innovation outcomes. Strong science and innovation policy needs to facilitate and encourage such structures.

The report should focus more on opportunities and threats to the existing innovation system, and not just its strengths and weaknesses. For example, is an (arguably) average level of BERD cause for complacency? The report makes no mention of the technological rise of India and China, nor of the size of subsidies in competitor countries, for example, the support of technology corridors in Singapore or Malaysia. The AIC believes that the question of how Australia can win the competition when all countries, including much bigger competitors, are scrambling up the same value chain, needs to be considered much more strategically.

III. The third concern is that commercialisation is defined quite broadly but used in a much more narrow sense in some of the recommendations. Although the intent may be clear to the careful reader, the risk is that the report is so voluminous that the reader (and media!) skimming it will misinterpret the meaning and context behind the recommendation. To the AIC, draft findings such as [6.1 *Decision making within universities in relation to the transfer, diffusion and utilisation of research outputs should not focus unduly on an objective of commercialisation to the detriment of maximising the social return from the public's investment]* are ripe for misinterpretation. To the AIC, such a suggestion only makes sense if 'commercialisation' is narrowly defined as 'exclusive sale or licensing of IP for potential profit' rather than the broader definition that implies transferring knowledge to a market.

Arguments about definitions are indeed fruitless but words can become overloaded. Commercialisation is defined in the report as [6.2 *the process of transforming knowledge and technology into marketable products, services, or processes]*. We agree. To the AIC, and as this definition would seem to imply, commercialisation is not only about economic returns, it is about achieving outcomes (products, services, or processes) with market take-up. In short, taking ideas to market. The price may or may not be zero. The path may include granting an exclusive licence, sharing IP, or transferring researchers or staff into industry. It can include contract research, not just IP transfer. It could include giving IP away to a developer.

This is therefore a major pathway for knowledge diffusion. To suggest that taking an idea to the market is necessarily a trade-off *with maximising the social return from the public's investment* is therefore quite incorrect. In fact, social return demands that some service delivery mechanism exists for delivery. Whether that mechanism is publicly or privately owned is beside the point, which is that to maximise social return the distribution network must be as extensive as possible. Successful commercialisation in fact seeks to maximise that service delivery and distribution network. The view that *[6.50 Where commercialisation is appropriate, such (financial) incentives can enhance social returns]* is correct, but probably intended in this case to imply that this is the exception rather than the rule i.e. the commercialisation path is more generally assumed to be through a single, private firm.

Hughes[2] makes the point there are "at least four potentially separable kinds of interactions which work at the university-industry interface. First, there is the basic university role of educating people and providing suitably qualified human capital for the business sector. Second there is the role of research activity and the role it plays in increasing the stock of codified knowledge which may have useful or commercial elements. Thirdly, there is a role in problem-solving in relation to specifically articulated business needs. Finally, one may identify a group of what one might term as 'public space' functions. These are relatively neglected but distinctive features of the role of universities in the economic and intellectual systems of nations. They include a wide range of interaction mechanisms between university staff and the business community. These range all the way from informal social interactions to specially convened meetings, conferences, specifically convened centres to promote, for instance, entrepreneurship and entrepreneurship activities, and the exchange of personnel including the role of internships. Each of these public space functions promotes a range of activities between the business community and the university sector. These may lead to the transfer not only of codified but also tacit knowledge and the establishment of relationships which may feed back into the other three roles."

The term 'commercialisation' is intentionally not used above because it may come into play in all four of these roles. Hughes goes on to state "just as we may identify these different potential areas of university-industry interaction, it is also important to recognise the different elements that individual universities may stress. This may reflect their own particular missions as well as the economic circumstances of the particular localities or regions within which some universities are located and the role they choose to play in relation to them. For instance, in a recent international collaborative study of regional patterns of university interactions, the Local Innovation Systems Project at MIT has developed a useful typology in which one can see the ways in which different dimensions of activity may develop and be most appropriate to different local economic development pathways. One pathway focuses on the creation of new industries in which the most important interactions would be along dimensions which emphasise leading edge science and engineering research, aggressive technology licensing policies, and the promotion or assistance of entrepreneurial businesses. Such circumstances may also lead to great emphasis on participation in standard setting and other activities which promote the rapid diffusion of particular technologies. A second pathway would emphasise the role of universities where the regional development strategy was focussed around the importation or transplantation of industries, for instance into formerly declining localities. In these circumstances responsive curricula to the needs of the newly transplanted or imported industries and associated education and manpower developments might receive more emphasis, along with technical assistance for the emerging subcontracting and supplying industries that the newly emerging implanted industry may require. Thirdly, to the extent that the local development strategy involves a diversification away from existing strengths into technological related new ones, then the university role may emphasise making bridges between otherwise disconnected actors in the local system and the filling of structural holes in the networks of activity and the creation of new industrial identities. Finally, in the case of upgrading existing industries, the problem-solving dimension and the use of faculty for consulting and contract-research may assume significance alongside activities designed to upgrade the skills of the educated labour force and a variety of activities

concerned with global, best practice scanning foresight exercises, and developing user supplier forums. The first key point here is that the variety of interrelationships available allows a rich set of possible patterns of interaction. There is no one true way."

A key point is made in *[6.6 Australia's success in commercialising knowledge and technology is often in industries that are not popularly thought of as being high-technology. Other examples are to be found in Australia's agricultural sector, including aquaculture and the wine industry]*. This is all about using commercialisation for incremental knowledge transfer to the overall benefit and strength of an industry, rather than narrow exploitation of monopoly rights to IP, as seems to be implied elsewhere in the report by the term 'commercialisation'. We also use it to make the important point that whether an industry *considers* itself to be high technology or not **is** irrelevant to the case for commercialisation. This is an important consideration to retain for our fourth theme below.

Yet commercialisation is treated cautiously at best in the findings, and we believe this is due to a narrow interpretation, that the benefits accrue to a single company selling a product to the market using exclusively acquired, but publicly funded knowledge. Commercialisation, even by the Commission definition, can and more often than not does, include broader knowledge transfer and can have social and environmental outcomes as well. Uniquest's commercialisation of Triple P (Positive Parenting Program) is one well known example in which global distribution of a public good program has been achieved through 'commercialisation'. It is doubtful that publication of the original underlying research in a journal would have been as efficient a diffusion mechanism as distribution through the parenting clinics established under the program by the private sector. As the report states, [*6.8 Knowledge diffusion mechanisms need to be efficient*], and commercialisation is one such mechanism. Unfortunately, its efficiency is not known ex ante. We would also point to the AIC's success in delivering its Commercialisation Bootcamp to the Antarctic Climate & Ecosystems (ACE) CRC, surely one of most public-good of all CRCs. Yet this CRC has been the AIC's largest repeat customer of these business-focussed training courses, with four private bootcamps held at the CRC over the past three years. The relationship between commercialisation and its role in knowledge diffusion and application is very strong. We disagree with the conclusion that *[9.46 the broad translation of research results]* need be in opposition to commercialisation.

To continue this point, the report states [*6.48/49 …the Commission questions whether decision making within universities in relation to the transfer and diffusion of knowledge and technology is now too driven by the objective of commercialisation*]. We would agree only if the term 'commercialisation' means an IP sale or licensing, but not if as we would prefer, 'commercialisation' is taken to mean 'creating market impact' instead. Indeed, as the next paragraph states, [*Ultimately, in terms of community wellbeing, it is the transfer, diffusion and utilisation of knowledge and technology that matters. The social return from public investment in R&D depends on: whether knowledge and technology is transferred out of universities (that is, whether it sees the light of day); ….whether the knowledge and technology is developed into some form of practical application (that is, whether it is taken up in some form or other that is welfare enhancing); and how widely the resulting innovation is utilised]*. In the end, commercialisation allows multiple pathways to the market, but the key is

market adoption. The AIC believes the report confuses this by using the term 'commercialisation' in a variety of different contexts. Perhaps a solution is to specifically refer to 'monopoly sale or licencing of IP' whenever that use is intended.

Regarding the potential reduction in spillover effects caused by such activity, one European study[3] notes "the evidence suggest that it is the larger firms that have a greater propensity to cooperate with PROs, probably because smaller firms face relatively more important transaction costs… Governments have fostered closer connections between public research and private firms taking for granted that this will accelerate the transfer of publicly sponsored research results to firms in knowledge-intensive industries and, pushed further by diffusion, increase the rate of innovation for the economy as a whole". In testing this assumption and the impact of a commercialisation focus at universities, the authors found that, "because of collaboration, labs tend to step-up their 'applied research and experimental development' and, to a lesser extent, their 'oriented basic research' while this shift is only marginally accompanied by a diminution in 'pure basic research'. Still, further research is needed to ascertain whether system dynamics that are promoting short-run interests of firms and PROs are on balance welfare-enhancing in the longer term". The report presented survey results concerning the "significance of various forms of collaboration between public laboratories and industry and the outcomes of collaboration. From this analysis it turns out that licensing is a less common channel for knowledge and technology transfer than joint research contracts, informal exchanges, conferences, or research consortia. This account from public laboratories in France therefore agrees with Cohen et al. (1994), who find a very similar ranking of knowledge and technology transfer channels for University-Industry Research Centres in the U.S. In particular, both underline the importance of publications, public meetings and conferences, and informal exchanges". Thus even when commercial relationships are actively pursued, these are not necessarily seen to be to the detriment of basic science and public disclosure.

However, some caution is in order. For example, "to the question of whether firms effectively restricted information for publications, we find that 26% of labs experienced this problem frequently or very frequently; the remainder never or rarely did so. Or for PROs with supervisory and funding roles, there could be a need to regulate contracts across-the-board to avoid situations in which the interests and bargaining power of firms forces an outcome that is detrimental to open science practices. This has been the trend in American research universities. For example, the rules set out in Stanford University's *Openness in Research* policy handbook allow publication delays of up to 90 days for collaborative R&D for patenting purposes or for sponsor review and comment on manuscripts". There are also unwanted spillovers restricting scientific communication, noting that "firms safeguard their competitive advantage by building tight fences around the knowledge produced within collaborations, in view of the spillovers that tend to be associated with the production of knowledge and the low cost its reproduction and transmission."

[3] John Goddard and Marc Isabelle, "Managing intellectual assets within knowledge-based partnerships: Insights from a survey of public laboratories collaborating with industry" , IMRI, Université Paris Dauphine, March 2006.

However, the survey noted that this was offset because of the "pervasiveness of joint ownership of results, which marks a new trend, because until the 1980s intellectual property used to be retained by the firms that sponsored the research. The ownership of results is usually implemented through patents, which by-and-large are co-owned...when firms interact, they can agree to joint ownership because this is complemented with contractual safeguards that prevent hold-up and maximise profits. For partnerships with PROs, there is instead a need for safeguards that curb the propensity to openly disclose and disseminate results to the scientific community, which would evidently hinder commercial exploitation through IP. The other side of the coin is that PROs seek to include clauses to re-use and publish possibly IP protected results." The real issue is therefore how to implement a contractual solution that balances the future foreseeable uses of the diverse partners – maintaining the positive spillover effects referred to by the Commission.

In this vein, the suggestion by the Commission that the simplification of CRCs to enhance multi-firm collaboration is sensible, but difficult. Although *[9.54 spillover benefits are likely to be higher because the research will be aimed at applications that are generic to multiple potential beneficiaries... progressively linking the level of public support to the number of firms involved in the collaboration],* our experience is that many firms participating in CRCs are not competitors. One-to-many collaborations can dilute the value to an individual firm of any created IP, since it is shared. We believe the simplest first step is to encourage one-to-one collaboration between a firm and a research organisation, so the benefits of doing so become observable to others in the industry. The spillover effect then is an increasing sophistication in the Australian business culture to accept the benefits of collaboration. The second natural step is next to encourage multi-firm collaboration, once the participating firms are attuned to the benefits derivable through cooperation. This is particularly true with SMEs, where the AIC experience has been that firms are unwilling to even contemplate full-cost collaborations which are perceived as unknown, high-risk, and open-ended. To attempt to resolve arguments about IP ownership and use that will arise in a multi-firm collaboration, when a firm has never previously been involved in collaboration, is a step too far for most.

On the issue of intellectual property management, the AIC has long advocated strengthening IP management for publicly funded research organisations, a central tenet being 'use it or lose it'. We advocate the use of IP by the provider to achieve outcomes; and if the provider cannot achieve those outcomes on their own, they should divest it. With the proviso on the overloading of the term 'commercialisation' already noted, the AIC has no problem with the sentiments expressed in [6.51 *However, an undue focus, or unquestioning focus, on commercialisation can reduce the social return from the transfer, diffusion and utilisation of knowledge and technology. Again to illustrate, if the knowledge or technology is generally applicable to a wide range of firms and the costs of further development and replication of the resulting innovation are low, the intellectual property should arguably just be given away. In this case, seeking to protect the intellectual property and sell or license simply delays its transfer and diffusion, potentially imposing substantial costs on firms and the wider community]*. We point out once again that commercialisation need not impede giving away

IP, nor does it per se imply any sort of monopoly distribution rights. However, such sentiment is not fairly expressed in the draft finding 6.1, which with its current wording, might imply that undue focus does exist on attaining monopoly rights.

We note also that openness with IP is not necessarily inconsistent with commercialisation, as implied in the report. MIT's founder William Barton Rogers created MIT with the heritage "…the interests of Commerce and the Arts, as well as of General Education, call for the most earnest cooperation of intelligent culture with industrial pursuits". The Director of the MIT Entrepreneurship Centre states[4] "genius inventions are not enough. The job is not done until a new technology is…reduced to practice; effectively commercialised; and evangelised until it becomes a global standard". He goes on to claim "successful commercialisation of your invention is the most effective way to diffuse your innovation". In fact, MIT's primary patent and licensing goal is the "creation and dissemination of knowledge'; its secondary goal is "technology transfer and company start-ups". Other goals are to maximise benefits to general society, enhance the educational process, create companies and jobs, provide funds to patent future ideas, and to provide modest income to MIT.

IV. The fourth theme relates to the role of SMEs in the innovation system and the perception that commercialisation entails transfer of cutting-edge science.

The report states *[6.29 However, only a relatively small proportion of SMEs are likely to be capable of commercialising cutting-edge science. A PMSEIC working group (2005) on growing technology-based SMEs, reported results from the May 2004 Sensis Business Index (p. 74). A sample of 1800 SMEs were asked to identify whether they were high, medium-high, medium or low technology-based businesses. The results suggested that 70 per cent of SMEs have a low technology profile, 17 per cent have a medium technology profile and only 13 per cent have a medium-high and high technology profile (p. 74).*

In terms of the transfer of cutting-edge science, it is not clear there is a problem with the linkages between technology-based SMEs (as noted above, around 13 per cent of SMEs) and research organisations. These are the SMEs that are most likely to be capable of commercialising the knowledge and technology generated by research organisations.]

These comments might imply that commercialisation entails the transfer of cutting edge science. In the case of university collaborations, it has firstly been the AIC's experience that in most cases, it is the adaptation of scientific knowledge or technology (rather than cutting edge science) to an existing product, process, or service to create an incremental innovation that is the most common form of SME innovation. Secondly, while the existing profile of an organisation might be an indicator of its absorptive capacity, it does not necessarily reflect its need or customer demand. In fact, the low technology firms may in fact have the greatest need for assistance in technology adoption and yield the greatest benefits from working with a research organisation. Thirdly, the academic literature strongly suggests the pivotal role of SMEs in the innovation process, particularly because of their agility in response to customer demands. The suggestion that linkages are unimportant simply because *[6.30 'linkages with*

[4] K.P. Morse, "Experiences of MIT", MIT Entrepreneurship Centre, speech in Wellington, NZ, July 2006.

research organisations'] was not listed by SMEs as a key growth factor is ludicrous, since it is but one solution to the more general problem of *[6.30 developing innovative solutions to customer problems]* that **does** appear in that list.

Linkages between SMEs and research organisations are important for other reasons as well. Broader dimensions of knowledge transfer including business know-how, management education, design, marketing, and identification of technological opportunities are all particularly important to SMEs in services industries.

Hughes[2] provides survey data comparing US and UK SMEs, and notes that "US companies more frequently rate their interactions with universities as highly important for their innovative activities... US companies in particular more frequently place a high importance on the admittedly infrequent licensing interaction, as well as joint R&D and problem-solving and on post-doctoral and graduate recruitment and internships". He notes that "customers, suppliers, competitors and internal knowledge within the organisation are the dominant sources of knowledge for innovation". However, "the US firms in all size-classes appear more likely to rate universities highly as sources of knowledge. However, it also shows that the smaller firms in the UK lag most behind US counterparts in attributing significant importance to universities as a source of innovation-related knowledge". The evidence from the Sensis survey might suggest that Australian firms fall into the same category.

Hughes concludes that "in both countries university-business innovation related interactions are a small part of the overall innovation system and must be seen in that light. … it is to emphasise the need to craft university focussed innovation policy with close attention paid to the full set of relevant interactions. The second policy implication arises from the observed depth of, and degree of importance attached to, business-university interactions in the US compared to the UK. This finding implies that if the US is to be the policy role model then *attention should be paid to raising the quality of interactions* rather than increasing their incidence. Finally it appears that in the UK the *smaller businesses are less likely to be involved in and place importance on university interactions*. These findings and the importance of focusing beyond spin offs and licensing confirm qualitative arguments to the same effect in the recent influential innovation policy review carried out by Richard Lambert (HM Treasury (2003)). The main conclusions of the Lambert review relevant to this paper were that the principal challenge facing the effective exchange of knowledge of the university-industry frontier in the UK lay in *raising the effectiveness of good quality business demand for research from all sources including universities.* The report also argued that there was a case for making greater business inputs into the nature of university courses and curricula in the UK. The report also made a strong plea for the switch of R&D support policy to promote interaction between universities and smaller firms."

The AIC believes that this provides further evidence for the role of intermediaries in establishing high quality university-industry links, and providing particular assistance to small businesses. Knowledge application based on business (demand) pull-through is likely to be a fruitful outcome in the longer term. In addition, firms' cooperation with universities will come to be accepted as a way to increase the firm's absorptive capacity and, indirectly, its ability to

pursue technological, market driven development. As Ken Morse puts it "people and dialogue are key; published lists of IP are not very useful".

A Swedish study[5] has revealed that "indirect effects of industry-university interaction also seem to be very important. In the literature, two types of university inventions are often depicted: those that are 'ready to use' for a firm and those that are 'embryonic' in nature, needing further development to be useable by industry….Previous research has found that ideas for innovations come from customers, clients and (to some degree) from competitors. Our results point to the importance of learning and orientation from university cooperation, which enables the firm to translate these market opportunities into technical or organizational problems. Furthermore, firms are able to strengthen their networks and manage their human capital through innovation. Collaboration indeed seems to improve firms' internal innovation capability. Furthermore, benefits from collaboration with universities are for some firms achieved through leverage of research investments. Cooperation seems to allow some firms to reduce costs and risks associated with research. Thereby, firms are becoming more efficient innovators. This type of argument is found to provide a second credible explanation for how collaboration helps firm become more innovative." These findings are consistent with the AIC's own data from its TechFast program.

The AIC agrees with the list of barriers faced by SMEs in collaborating with research organisations given on page 6.30. However, the assertion that *[6.32 .. perceptions about these linkages in Australia appear to be coloured by concerns about the transfer of cutting-edge science*] is baseless. The barriers are real and sufficiently high to prevent hundreds of SMEs that the AIC has interviewed from establishing collaborations. Furthermore, rather than being a *supply-push perspective*, the AIC is advocating a demand-pull perspective, in which the needs of the SME and its customers determine the appropriate form of collaboration. The transfer of cutting edge science is not favoured over other forms of knowledge or technology diffusion, as implied by the assertion. The suggestion that [*subsidies distort decision making about the optimal path of commercialisation]* reflects a misunderstanding of the risk that knowledge transfer implies for both parties i.e. the research organisation and the SME. In the AIC's view, the policy objective should be to engender a cultural change that encourages more SMEs to work collaboratively with research organisations in order to increase the spillover effects of public investment in R&D. As the Commission notes, *[6.48 (governments could consider) addressing the impediments within universities that constrain the transfer, diffusion and utilisation of knowledge and technology. This includes working to improve the interface between universities and the business sector]*. Encouraging more SMEs to participate in this process in the manner described in the AIC's submission has the benefits of both additionality and spillover that the Commission seeks.

[5] Anders Broström and Hans Lööf, "What do we know about Firms' Research Collaboration with Universities? New Quantitative and Qualitative Evidence", 28 August 2006. CESIS.

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